SHORT COMMUNICATION

Application of E-learning to Adapt Medical Education during the COVID-19 Pandemic: Experience of a Developing Country

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Background: The COVID-19 pandemic has created significant challenges in medical education. The traditional educational model was accepted as a gold standard before COVID-19. However, in the context of the pandemic, it was necessary to provide educational programs through e-learning emphasizing effective interactions.

Method: In this study, an attempt has been made to examine the experience of Mashhad University of Medical Sciences regarding adaptation in training medical students and residents in the face of the COVID-19 pandemic, emphasizing maintaining the safety of students, residents, faculty members, and patients.

Results: In the face of the Covid-19 pandemic, the faculty of medicine of Mashhad University of Medical Sciences used novel methods, including the flipped classroom, virtual classes, electronic educational materials, and telehealth clinics. In addition, virtual education was conducted with students' and residents' involvement by holding morning reports, case reports, and virtual club journal meetings jointly and in collaboration with various training groups. In total, 9638 electronic educational content and 1648 webinar sessions were implemented. Other approaches carried out during the pandemic were planning electronic assessments and conducting online tests.

Conclusion: Education with digital technologies and e-learning facilities can partially fill the educational gap in conditions like the COVID-19 pandemic.

Keywords: COVID-19, Virtual Education, E-learning, Medical Education, Technology Enhanced Learning

تطبيق التعلم الإلكتروني لتكييف التعليم الطبي أثناء جائحة COVID-19: تجربة دولة نامية

الخلفية: لقد خلق جائحة COVID-19 تحديات كبيرة في التعليم الطبي. تم قبول النموذج التعليمي التقليدي كمعيار ذهبي قبل COVID-19. ومع ذلك ، في سياق الوباء ، كان من الضروري توفير برامج تعليمية من خلال التعلم الإلكتروني مع التركيز على التفاعلات الفعالة.

الطريقة: في هذه الدراسة ، جرت محاولة لفحص تجربة جامعة مشهد للعلوم الطبية فيما يتعلق بالتكيف في تدريب طلاب الطب والمقيمين في مواجهة وباء COVID-19 ، مع التأكيد على الحفاظ على سلامة الطلاب والمقيمين وأعضاء هيئة التدريس. والمرضى.

النتائج: في مواجهة جائحة Covid-19 ، استخدمت كلية الطب بجامعة مشهد للعلوم الطبية طرقًا جديدة ، بما في ذلك الفصول الدراسية المقلوبة والفصول الافتراضية والمواد التعليمية الإلكترونية وعيادات الرعاية الصحية عن بُعد. بالإضافة إلى ذلك ، تم إجراء التعليم الافتراضي بمشاركة الطلاب والمقيمين من خلال عقد تقارير صباحية وتقارير حالة واجتماعات يومية افتراضية للنادي بشكل مشترك وبالتعاون مع مجموعات تدريبية مختلفة. في المجموع ، تم تنفيذ ٩۶٣٨ محتوى تعليميًا إلكترونيًا و ١۶۴٨ جلسة ندوات عبر الإنترنت. ومن الأساليب الأخرى التي نُفِّذت أثناء الوباء ، التخطيط للتقييمات الإلكترونية وإجراء الاختبارات عبر الإنترنت.

الخلاصة: يمكن للتعليم باستخدام التقنيات الرقمية ومرافق التعلم الإلكتروني أن يملأ جزئيًا الفجوة التعليمية في ظروف مثل جائحة COVID-19.

الكلمات المفتاحيه: COVID-19 ، التعليم الافتراضي ، التعلم الإلكتروني ، التعليم الطبي ، التعلم المعزز بالتكنولوجيا

COVID-19 وبائی مرض کے دوران طبی تعلیم کو اپنانے کے لیے ای لرننگ کا اطلاق: ایک ترقی پذیر ملک کا تجربہ

پس منظر: COVID-19 وبائی مرض نے طبی تعلیم میں اہم چیلنجز پیدا کیے ہیں۔ روایتی تعلیمی ماڈل کو COVID-19 سے پہلے سونے کے معیار کے طور پر قبول کیا گیا تھا۔ تاہم، وبائی مرض کے تناظر میں، موثر تعاملات پر زور دیتے ہوئے ای لرننگ کے ذریعے تعلیمی پروگرام فراہم کرنا ضروری تھا۔

طریقہ: اس مطالعہ میں، مشہد یونیورسٹی آف میڈیکل سائنسز کے تجربے کا جائزہ لینے کی کوشش کی گئی ہے جس میں کووڈ-۱۹ کی وبا کے دوران طبی طلباء اور رہائشیوں کی تربیت میں موافقت کے حوالے سے طلباء، رہائشیوں، فیکلٹی ممبران کی حفاظت کو برقرار رکھنے پر زور دیا گیا ہے۔ ، اور مریض۔

نتائج: Covid-19 وبائی مرض کے پیش نظر، مشہد یونیورسٹی آف میڈیکل سائنسز کی فیکلٹی آف میڈیسن نے نئے طریقے استعمال کیے، جن میں فلپ کلاس روم، ورچوئل کلاسز، الیکٹرانک تعلیمی مواد، اور ٹیلی ہیلتھ کلینک شامل ہیں۔ اس کے علاوہ، ورچوئل ایجوکیشن کا انعقاد طلباء اور رہائشیوں کی شمولیت سے صبح کی رپورٹس، کیس رپورٹس، اور ورچوئل کلب جرنل میٹنگز کا مشترکہ طور پر اور مختلف تربیتی گروپوں کے تعاون سے کیا گیا۔ مجموعی طور پر، ۹۶۳۸ الیکٹرانک تعلیمی مواد اور ۱۶۴۸ ویبینار سیشنز کو لاگو کیا گیا۔ وبائی امراض کے دوران کیے جانے والے دیگر طریقوں میں الیکٹرانک تشخیص کی منصوبہ بندی کرنا اور آن لائن ٹیسٹ کرنا تھا۔

نتیجہ: ڈیجیٹل ٹیکنالوجیز اور ای لرننگ کی سہولیات کے ساتھ تعلیم کووڈ-۱۹ کی وبا جیسے حالات میں تعلیمی خلا کو جزوی طور پر پر کر سکتی ہے۔

مطلوبہ الفاظ: COVID-19، ورچوئل ایجوکیشن، ای لرننگ، میڈیکل ایجوکیشن، ٹیکنالوجی بہتر سیکھنے

بکارگیری یادگیری الکترونیکی جهت انطباق آموزش پزشکی در مواجهه با همه‌گیری کووید ۱۹: تجربه یک کشور در حال توسعه

زمینه و هدف: همه‌گیری کووید ۱۹ چالش‌های مهمی را در آموزش پزشکی ایجاد کرده است. مدل آموزشی سنتی قبل از کووید ۱۹ به عنوان یک استاندارد طلایی پذیرفته شده بود و به کار می‌رفت. با این حال، در شرایط همه‌گیری ارائه برنامه‌های آموزشی در قالب یادگیری الکترونیکی و با تأکید بر تعاملات اثربخش ضروری می‌نمود.

روش: در این مطالعه سعی شده است تجربه دانشگاه علوم پزشکی مشهد در خصوص ایجاد انطباق در آموزش دانشجویان پزشکی و دستیاران تخصصی بالینی در مواجهه با همه‌گیری کووید ۱۹ با تأکید بر حفظ ایمنی دانشجویان، دستیاران، اساتید و بیماران مورد بررسی قرار گیرد.

یافته‌ها: در مواجهه با همه‌گیری کووید ۱۹، دانشکده پزشکی دانشگاه علوم پزشکی مشهد از روش‌های نوینی از جمله کلاس درس معکوس، کلاس‌های مجازی، محتوای آموزشی الکترونیکی و کلینیک‌های پزشکی از راه دور استفاده نمود. به علاوه، آموزش مجازی با مشارکت دانشجویان و دستیاران تخصصی بالینی با برگزاری جلسات گزارش صبحگاهی، گزارش موردی، ژورنال کلاب مجازی به صورت مشترک و با همکاری گروه‌های آموزشی مختلف انجام پذیرفت. در مجموع، ۹۶۳۸ محتوای آموزشی الکترونیکی و ۱۶۴۸ جلسه وبینار اجرا گردید. از دیگر رویکردهای مورد استفاده در طول همه‌گیری، می‌توان به برنامه‌ریزی جهت ارزیابی الکترونیکی دانشجویان و برگزاری آزمون‌های آنلاین اشاره نمود.

نتیجه‌گیری: آموزش با فناوری‌های دیجیتالی و استفاده از امکانات یادگیری الکترونیکی می‌تواند تا حدی شکاف آموزشی را در شرایطی مانند همه‌گیری کووید ۱۹ پر نمایند.

واژه‌های کلیدی: کووید ۱۹، آموزش مجازی، یادگیری الکترونیکی، آموزش پزشکی، یادگیری ارتقاءیافته با فناوری

INTRODUCTION

The unexpected occurrence of the coronavirus (COVID-19) pandemic and the lack of opportunity to adapt to this new situation is a challenge that threatens medical education. In addition to the regular education task, university hospitals also had to cover the care of COVID-19 and non-COVID-19 patients (1). The changes imposed by the pandemic have a greater impact on medical students' and assistants' education than any others. According to Mack et al.'s experience, engaging medical students in telemedicine and virtual education provides additional learning experiences that will increase their proficiency (2).

For many years, the transition from traditional to virtual education posed some challenges for the medical education system worldwide; our university is no exception. Several factors were important in not attending virtual learning. The most underlying factor could be insufficient technological and computer skills to create appropriate digital content (3). It was challenging for faculty to teach and communicate electronically with students in a student-free room or at home. Faculty members should adjust their teaching methods to a passive learning environment, especially if they did not have adequate information technology infrastructure. In contrast, students were likely to be more familiar with electronic environments (4). Internet access, poor bandwidth, low-quality e-learning content, and restrictions on access to required equipment were the main infrastructure barriers that affected the development and implementation of virtual education.

Generally, Norris and Lefrere suggested several steps universities must take to pioneer online education. Their suggestions included the following:

- Use new technologies to evolve and sustain new educational models;
- Re-plan and implement teaching, learning, and assessment methods;
- Consider values and do not just focus on quality;
- Change the role of teachers and mentors as well as peer learning;
- Transforming expense models by seeking lower price tools, enabling more rapid completion of electronic content, and reducing the cost of learning objects' production (5).

METHODS

The COVID-19 crisis has impressed medical education by shifting conventional educational methods to e-learning (6). During the pandemic, the education system must adopt effective approaches to deal with this abrupt disruption. However, the pandemic allowed us to launch a powerful e-learning program (7).

The virtual training center of medical school in our university adopted practical approaches to deal with difficulties in the development and implementation of e-learning during the COVID-19 pandemic, and different methods were proposed to respond to the challenges that existed; for example, we attempted to train and empower faculty and students during the pandemic. Faculty members' essential basic educational need was the use of new communication and virtual educational gadgets. Therefore, teaching faculty members about setting up and using e-learning platforms was necessary to set new policies. Proficiency in this skill was essential for learners' progress, especially in the critical conditions of the pandemic era (4, 7). Several workshops were held to train and empower faculty members and students. During these courses, teachers learned virtual learning strategies, designed electronic educational materials and other required technological skills, and became familiar with the e-learning approaches. We used technology-based solutions to deliver educational conferences like *Skype*, *Adobe Connect*, and *Sky Room*. These platforms enable educational interaction between instructors and learners along with the implementation of physical distance instructions (8,9). In these methods, faculty could answer participants' questions in a two-way interactive discussion. Also, they mastered different skills in using various software and platforms. On the other hand, they were trained to manage and organize e-contents on MUMS's learning management system (LMS).

In addition, interdisciplinary training conferences, clinical rounds, case reports, journal clubs, and similar sessions that required a group of people to come together were stopped and transferred to a virtual format. Using a webcam in virtual classrooms helped maintain two-way interaction by showing the faces of the two parties during the conversation. Also, the teacher could call students when needed. Using innovative teaching methods, such as gamification, increased the effectiveness of virtual teaching (10,11). Virtual training sessions could be more effective, interactive, and fun than pre-pandemic face-to-face sessions. This style of teaching could sometimes lead to greater audience participation. For example, in one platform type, students can draw or label simultaneously on the professor's PowerPoints (5).

Moreover, we tried to develop our technological infrastructure; however, we increased the local bandwidth and the number of servers to manage the network traffic. In addition, different stations were prepared and equipped with computers and required high-tech digital devices to facilitate content production for faculty members. IT support technicians should have tested infrastructure to minimize stressful issues.

According to the experience of other universities, in most of them, a separate section was initially set up to train, assist, and support faculty and students. So, a professional office was needed to enhance the communication between teachers and students, share experiences, develop virtual education strategies, and organize and manage online educational programs. Therefore, providing a silent, disconnection-free, and equipped place for faculty and students was inevitable. So, we established the medical school virtual training center. This center offered various services such as consulting services, uploading e-content on the LMS, and solving potential problems. At last, we monitored, evaluated, and provided feedback on the quality of educational materials to improve e-learning to reach academic goals. Online courses were evaluated regularly, and constructive feedback was obtained to improve educational purposes. One of the important tasks of the virtual education

committee was to review student feedback on virtual sessions in order to keep their training as intact as possible during the pandemic. Learning assignments included engagement in interdisciplinary sessions or morning reports, using simulation skill labs, or virtual clinical patient care were provided. Finally, debriefing sessions and group discussions with educators and program managers to meet the needs of different learners using video facilities might effectively reconstruct face-to-face sessions (4).

RESULTS

In the continuation of this section, the performance report of the medical school of MUMS from February 20, 2020, to June 20, 2020, is presented in Table 1.

While written exams are the most common method of student assessment, the pandemic forced us to replace virtual and remote assessment methods. The new assessment methods and the online multiple-choice question exams already used included computer-based patient management problem (PMP) exams, written assignments, and online verbal examination sessions (12).

DISCUSSION

The forced changes that Covid-19 made to the academic system will last for a long time. Fortunately, this pandemic occurred at a time when the capabilities of information technology, such as artificial intelligence, were well advanced. All of these led to the transformation of the university education system. Sharing the experiences of medical universities around the world can be helpful for more effective training of students and residents and adapting education to the pandemic. These innovative experiences of other universities can reduce the gap created in the education of medical students during a pandemic.

The present researchers designed various novel approaches, including the virtual rounds using the webinar platform which was conducted by smartphones, and a particular gadget designed by the university virtual training center to provide skills training. The treatment process was explained to residents during the virtual training round and live visits of patients and meeting participants. With the help of the gadget, educators could conduct a clinical round from the patient's bed, which included taking a history, clinical examination, and reviewing laboratory tests and radiology images of the patient. Faculty members performed remote clinical rounds and patient discussions via *Sky Room*, *Skype*, *Adobe Connect*, or other available teleconferences platforms. Multidisciplinary clinical rounds were continued by the supervision of clinical staff and the participation of medical and nursing students and residents, nurses, pharmacists, and related basic science staff like biochemists or virologists via web-based resources. In addition to online training and clinical round, a combination of other virtual training methods, such as telemedicine, virtual patients, and simulations, were helpful. Medical students took part in telemedicine visits by taking medical chief complaints, reviewing patients' histories, and charting their differential diagnoses. The present researchers also know that none of these methods is a good alternative to practical patient bedside training, but it can be used as a way to stay not far away from training during a pandemic. Planning electronic exams and assessments on the platform of the medical assessment center of MUMS (such as home-based exams and online PMP examinations), formative assessments, and portfolios on the LMS were the other approaches that were done during the pandemic.

In conclusion, based on the current facilities, we did our best to ensure that medical education was not quarantined during the pandemic. Online and new technologies in the field of medical education have been able to effectively facilitate interactive classes and bedside education without threatening the health of students, educators, and staff. The Corona crisis has created challenges and opportunities in medical education. Training and empowering faculty and students during the pandemic seems necessary, and technological infrastructure improvement is inevitable. As the evidence shows, we need to involve new methodologies to optimize virtual education and effective training (13-14).

Ethical Considerations: Ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc., have been completely observed by the authors.

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Conflict of interest: None

Table 1. The performance report of the faculty of medicine, Mashhad University of Medical Sciences

Number of Webinars	Number of Students/Residents	Number of Sources	Type of Training	Degree
1225	18020	3437	Basic science education	Basic Sciences (General Medicine Basic Sciences/Postgraduate Basic Sciences)
423	2546	1506	Clinical education	General Medicine Clerkship Stage
	2400	4477		General Medicine Internship Stage
	3349	218		Clinical Assistant (Residency)
		26315		Total Per Capita Students by Courses/Departments
		9638		Total Number of Sources (Content)
		2516		Total Number of Assignments/Portfolios

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